

NON-PUBLIC?: N

ACCESSION #: 9107160290

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Zion Unit 2 PAGE: 1 OF 05

DOCKET NUMBER: 05000304

TITLE: Unit 2 Reactor Trip Due to a Failed Capacitor in the Steam
Generator Automatic Feedwater Control Circuitry

EVENT DATE: 06/11/91 LER #: 91-0

4-00 REPORT DATE: 07/11/91

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 017

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10
CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Suzanne L. Mika ext. 2323 TELEPHONE: (708) 746-2084

COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: JB COMPONENT: LC MANUFACTURER: H015

REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On June 11 1991, during Unit 2 plant startup, several unsuccessful attempts were made to use the bypass Feedwater Regulating Valves (FRV) SJ! in the automatic mode to control steam generator (S/G) level JO! while the unit operators were aligning the main feedwater pumps. The main feedwater system SJ! was successfully aligned with the bypass FRVs in the manual mode and the main turbine speed was increased to 1800 rpm. After the main generator was synchronized to the grid, the unit operators attempted to place the main FRVs in automatic and to close the bypass FRVs in manual. The main FRVs filled the S/Gs to 70% which then generated a turbine trip signal which then generated a reactor trip because reactor power was greater than 10%.

This event was caused by a failed capacitor in the power supply circuitry of the S/G level controller. Contributing to this event was a history of problems with leaking bypass FRVs. This lead to the incorrect diagnosis by the unit operators that the leaking bypass FRVs were causing the S/G level control problems. During this event all actions taken were within the bounds of the Technical Specification Limiting Conditions for Operation and there was no safety significance to this event. Corrective actions included determining the root cause of the capacitor failure, reviewing the S/G level control system to determine what information should be provided to the unit operators, identifying recurring Feedwater System problems, and verifying the calibration of the bypass FRV controller.

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END OF ABSTRACT

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A. CONDITION PRIOR TO EVENT

MODE 1 - Power Operation RX Power 17%

RCS AB! Temperature/ Pressure 549 degrees F / 2235 psig

B. DESCRIPTION OF EVENT

On June 11, 1991, Unit 2 plant startup was in progress. The Reactor was critical with the secondary plant components being started up per General Operating Procedure (GOP)-2 "Plant Startup". Auxiliary Feedwater Pumps (AFP) BA! were feeding the steam generators (S/G). At 0935, 2C Main Feedwater Pump (MFP) SJ! was being started and lined up to feed the S/Gs. The Bypass Feedwater Regulating Valves (FRV) SJ! were placed in automatic to control S/G level JB!. S/G levels increased and the bypass FRVs were still going open which was contrary to system design. The operators were involved in aligning AFPs for power operation which requires the AFPs to be started and the AFP discharge throttle valves set to produce 110 gpm flow to each S/G. While the operators were concentrating on aligning the AFP for power operation, one AFP failed to start and was declared inoperable at 0946. While the AFPs were being aligned for power operation, the S/Gs were continuing to fill due to improper operation of the bypass FRV. At 0957, S/G 2A reached 70% level and the High Steam Generator Level Permissive (P-14) signal was generated. P-14 is a turbine protection signal which automatically trips the main feed pumps and main turbine, and automatically closes the main FRVs and bypass FRVs on the affected S/G when two out of

three level transmitters on the affected S/G are greater than 70%. A turbine trip will generate a reactor trip if power is greater than 10%. When 70% was reached in 2A S/G, the 2C main feedwater pump (MFP) tripped and the bypass FRVs closed as designed. Although the operators had noticed improper operation of bypass FRVs, the consensus of the Control Room personnel was that it was the distraction of aligning the AFPs for power operation, along with feedwater valve leakage that caused the high level in the S/Gs. Feedwater valve leakage has been a historical problem at Zion. Operator experience lead to the assumption that most problems with automatic controls at low power levels were due to leakage. Since an AFP had been declared inoperable, Technical Specification Limiting Condition for Operation (LCO) 3.7.2 was entered and therefore the mode change to power operations could not be performed until the AFP was declared operable.

The AFW pump was repaired and declared operable at 1745 (DVR 2-91-044). The plant startup was recommenced and the 2C MFP was again started at 1830. Automatic operation of the bypass FRVs was attempted several times. However, when the bypass FRVs were placed in automatic, they continued to fill the S/Gs above their normal operating level. At 2010, 2C MFP was manually tripped to prevent reaching 70% in 2 S/Gs. A second attempt was made to start 2C MFP at 2035. Bypass FRVs were kept in manual although automatic operation was attempted. Turbine rollup commenced at 2054 and the turbine reached 600 RPM. Different feedwater controls were operated in manual including feedwater containment isolation valves, bypass FRVs, and MFP speed. Although the turbine reached 600 RPM, 70% level was reached on 2D S/G and a P-14 signal was generated. The 2C MFP tripped along with the main turbine.

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B. DESCRIPTION OF EVENT (CONT)

A new shift came on at 2300. The feedwater containment isolation valves were throttled for A, B, and C S/G and the D S/G containment isolation valve was 3-5 seconds open (60 seconds is full stroke time). The bypass FRVs were in manual and the shift turnover report stated that the bypass FRVs would not control in automatic and were leaking severely. The feedwater pump differential pressure control was considered difficult to control. At 2111, 2C MFP was started again. Although difficult to control, the main feedwater system was placed in service and the main turbine speed was increased to 1800 RPM. After these evolutions, the S/G levels were considered to be fairly stable. At 2346, the main generator was energized and synchronized to the grid. With reactor power increasing, GOP-2 required main FRVs to be placed in automatic and bypass FRVs to be closed. In anticipation of this evolution, the feedwater containment isolation valves were fully opened. The turbine ramp rate was increased from .5%/min to 1%/min. As the main FRVs were placed in automatic to open, the bypass FRVs were closed in manual per procedure. The main FRVs ramped open above program and filled the S/Gs to 70%. S/G 2D reached 70% first and a P-14 signal was generated at 2355. This tripped the main turbine and the 2C MFP, and closed the main FRV and bypass FRV. Since power was greater than 10%, a reactor trip also occurred. The plant emergency procedures were entered and the reactor was stabilized in Hot

Shutdown.

C. APPARENT CAUSE OF EVENT

The primary cause of this event was the failure of a capacitor in the power supply circuitry of the S/G level controller. This capacitor filtered AC ripple voltage to provide DC voltage that was then supplied to the rest of the level controller's internal components. When the capacitor failed, AC ripple voltage was supplied directly to the controller's internal components causing the limiting components to fail. Because the limiting components provide a reference level signal to the S/G level controllers, when these components failed, the level controller supplied the S/Gs with a reference level of 100%. When the main FRVs were placed in automatic and the bypass FRVs were placed in manual, the 100% level signal from the level controller caused the main FRVs to continue to fill the S/Gs until the 70% setpoint level was exceeded. When S/G level reached 70%, a P-14 signal caused the main turbine to trip which then caused the Unit 2 reactor to trip since reactor power was greater than 10%.

Contributing to this event was a history of problems with leaking main and bypass FRVs. The unit operators determined that leaking bypass FRVs were causing the S/G level control problems. This diagnosis was passed from shift to shift without any additional independent assessments forming a different conclusion. HPES interviews were held with many operating personnel following the event and all write-ups of operating personnel were reviewed. During the initial stages of the FW system startup, problems with S/G level control were encountered and the problem was diagnosed as

leaking bypass FRVs. However, post trip discussions revealed that the control board indications did not completely agree with this diagnosis (i.e. bypass FRVs went open when placed in auto even while at or above program level and the 5% deviation alarm never cleared when program level and S/G level were in agreement). The complexity and level of activity associated with FW control during start-up, coupled with this activity being spread over several shifts, and operators' intuition based on a history of problems with valves leaking through, may have compromised a thorough diagnosis of the event. Additionally, when information was passed from shift to shift and/or operator to operator the original diagnosis was always accepted.

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C. APPARENT CAUSE OF EVENT (CONT)

Also contributing to this event was that the S/G reference level indication was removed from the control board and replaced with indication of the differential pressure between the FW System and Steam pressure. This was done because the differential pressure indicator is more useful during power operations than the S/G reference level indicator. If this indicator had still been on the control board, the unit operator may have recognized that the automatic S/G level controller had failed high.

A review of GOP-2 revealed that step 60, which requires bypass FRVs to be placed in automatic, was not initialed. The procedure

required that if a step cannot be completed as required it may be exempted provided two Licensed Shift Supervisors (LSS) sign off on the "Exemption/Deletions" page. In this case, this was not done. Had two LSSs made the necessary evaluation to approve bypassing step 60, the level program error may have been recognized.

D. SAFETY ANALYSIS OF EVENT

During this event all failures and actions taken were within the bounds of the Technical Specification Limiting Conditions for Operation. There was therefore no safety significance to this event. All safe shutdown features worked as designed. Steam Generator Hi-Hi Override (P-14) is a turbine protection signal to prevent damage from moisture impingement on the blades.

E. CORRECTIVE ACTIONS

Human Performance Evaluation System (HPES) investigation 91-14 was performed immediately following this event, and also a team investigation was conducted which generated the following corrective actions:

1. Tech Staff, Mechanical Maintenance and Operating verified that all mechanical overrides were intact and not impeding the proper operation of the valves. Additionally, with no demand on the M/A stations, 0 psi diaphragm pressure was verified on all the valves per design.
2. The calibration of the loop D Bypass FRV Controller was verified by simulating inputs and verifying proper outputs. No

problems were found. Additionally, the valve was stroked and proper movement was observed.

3. A root cause analysis of the capacitor failure will be performed. (304-180-91-04301)

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E. CORRECTIVE ACTIONS (CONT)

4. A review of the S/G level control system will be performed to determine what control information should be provided to the operators. (304-180-91-04302)

5. Station management will review expectations desired from operators when performing tasks per approved procedures. (e.g. Instructions for Using GOP-2. EXCEPTIONS/DELETIONS and response to equipment which does not respond as expected.) (304-180-91-04303)

6. Training on this event will be given to the Operating Department to emphasize the need for an independent review when information is relayed among shift personnel. (304-180-91-04304)

7. A multi-department walkdown and review of the FW system will be performed to identify any recurring FW problems. Based on this review and walkdown, any necessary actions to correct these

problems will be resolved and the resolutions will be distributed to the appropriate personnel. (304-180-91-04305)

8. SOER 84-4 "Reactor Trip caused by Main Feedwater Control Problems" gives recommendations on switching Feedwater control between manual and automatic. An effectiveness review of SOER 84-4 will be conducted based on this event. (304-180-91-04306)

F. PREVIOUS EVENTS

A search was conducted of the LER/DVR Database using the System code of Feedwater. LER 1-88-005 describes a Reactor Trip which occurred due to slow response time of a Main Feedwater Regulating Valve. None of the corrective actions taken would have prevented this event.

DVR 1-88-137N1 documents an event where failed capacitors in the S/G level controller nearly caused a reactor trip. The corrective actions from DVR 1-88-137N1 would not have prevented this event.

G. COMPONENT FAILURE DATA

Manufacturer Nomenclature

Hagan Controls Summator

ZDVR LER-304(6)

Commonwealth Edison

Zion Generating Station
Shiloh Blvd. & Lake Michigan
Zion, Illinois 60099
Telephone 708 / 746-2084

July 11, 1991

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Dear Sir:

The enclosed Licensee Event Report number 91-004-00, Docket No. 50-304/DPR-48 from Zion Generating Station is being transmitted to you in accordance with the requirements of 10CFR50.73(a)(2)(iv), which requires a 30 day written report when any event or condition resulted in manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS).

Very truly yours,

T. P. Joyce
Station Manager
Zion Generating Station

TPJ/bh

Enclosure: Licensee Event Report

cc: NRC Region III Administrator

NRC Resident Inspector

INPO Record Center

CECo Distribution List

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*** END OF DOCUMENT ***
